UNDERGROUND DETENTION/ TREATMENT

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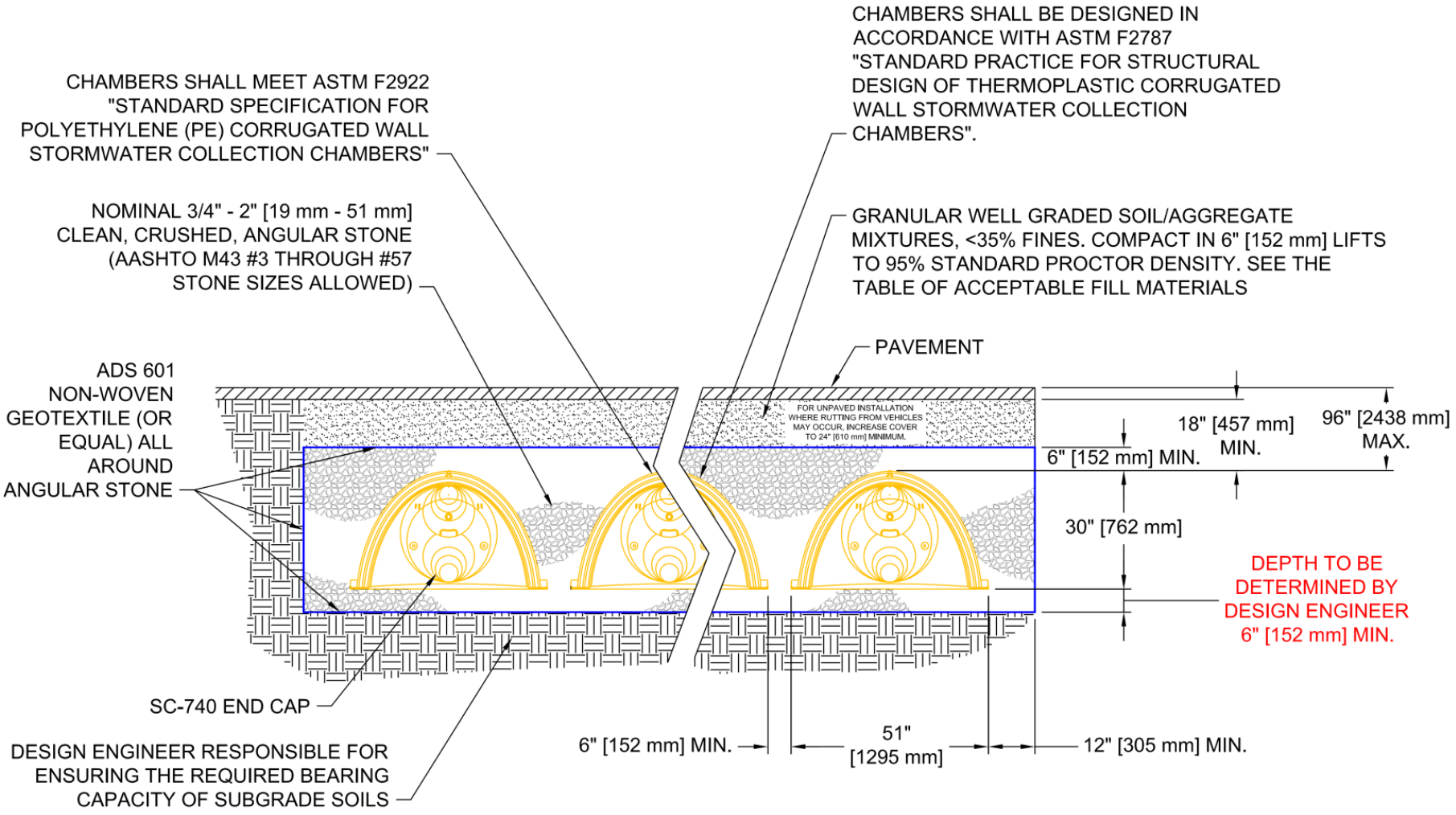
OVERVIEW

- ✓What is Underground Detention/Treatment?
- ✓Design Objectives
- ✓Manufacturers
- ✓Design Considerations
- ✓Maintenance
- ✓AE2S' Designs

WHAT IS UNDERGROUND DETENTION?



DESIGN OBJECTIVES/REQUIREMENTS

- Water Quantity Control
  - Rate Control (Pre vs. Post-Developed Conditions)
  - Volume Reduction?
- Water Quality Control
  - Typically 80% TSS Removal
  - Targeted Pollutant Removal?

International Stormwater BMP Database TSS Removal

Table 3. Influent/Effluent Summary Statistics for TSS (mg/L)

BMP Type	Count of Studies and EMCs		25th Percentile		Median (95% Conf. Interval)*		75th Percentile	
	In	Out	In	Out	In	Out	In	Out
Biological Filtration	4, 72	4, 72	12.0	2.4	20.5 (15.5, 25.9)	**3.5 (2.5, 4.0)****	35.1	5.0
Filtration	7, 125	7, 125	15.0	6.7	32.3 (23.0, 40.0)	**14.2 (10.0, 15.0)****	80.0	25.6
Inlet Insert	5, 53	11, 141	30.0	19.0	51.7 (37.0, 67.0)	**32.9 (24.0, 35.0)****	82.0	50.0
Multi-process	4, 41	4, 36	35.5	1.6	127.4 (41.0, 206.0)	**4.5 (1.7, 6.0)****	245.0	8.0
Manufactured Device-Physical	22, 487	22, 376	10.6	10.0	33.6 (26.8, 37.0)	29.7 (23.4, 36.0)	124.2	71.3
Oil/Grit Separators and Baffle Boxes	7, 51	8, 53	30.0	15.9	67.6 (35.2, 84.0)	37.3 (21.2, 59.8)**	129.1	87.0
Physical with Volume Control	5, 62	5, 62	20.4	3.8	41.2 (26.8, 47.6)	**7.1 (5.4, 8.8)****	66.1	16.0

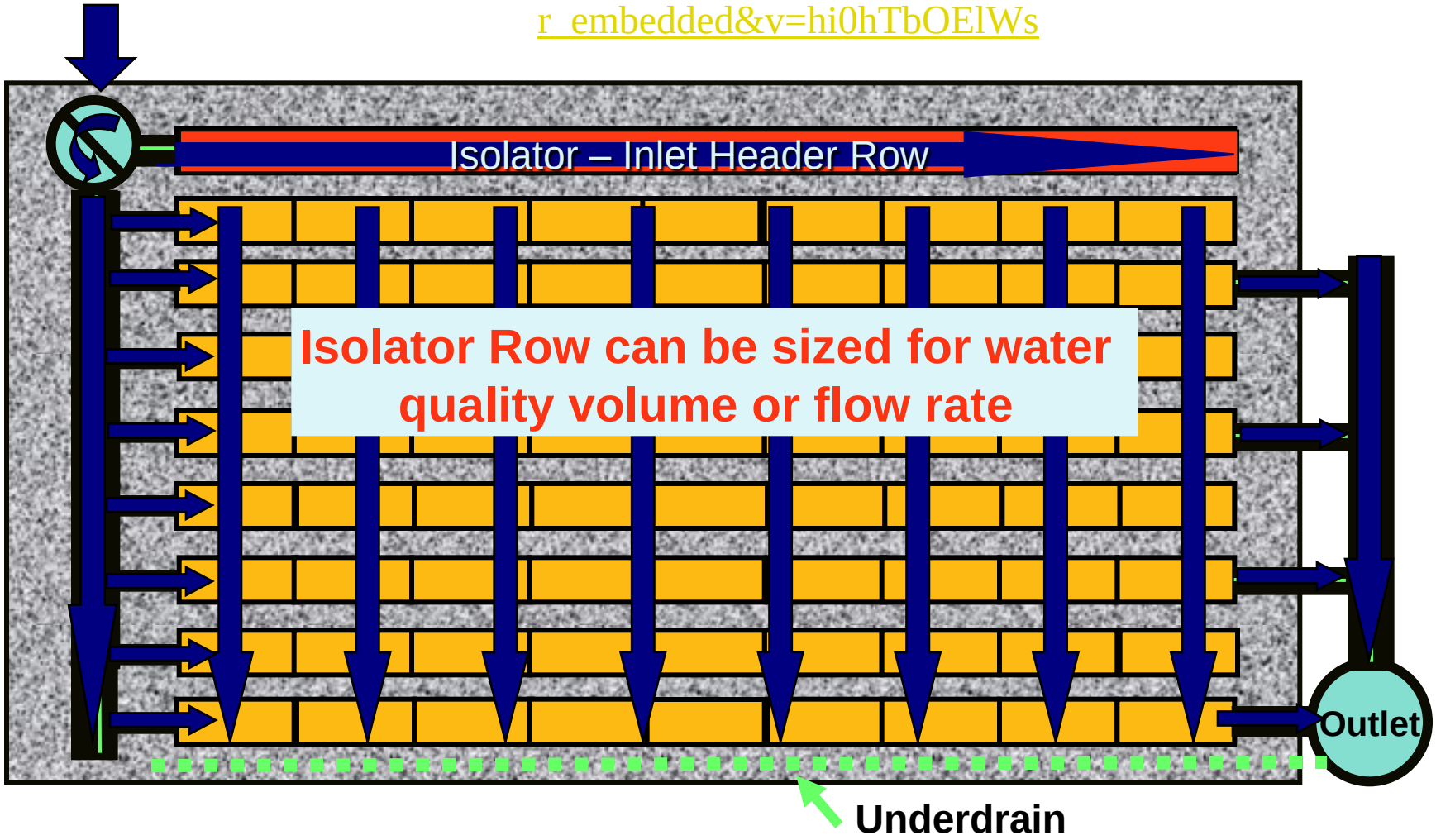
*Computed using the BCa bootstrap method described by Efron and Tibishirani (1993)

**Hypothesis testing using the Mann-Whitney test in Attachment 1 shows statistically significant decreases for this BMP category.

HOW DO THEY OPERATE?

From Optional Pre-Treatment

https://www.youtube.com/watch?feature=player_embedded&v=hi0hTbOElWs



ADS-StormTech

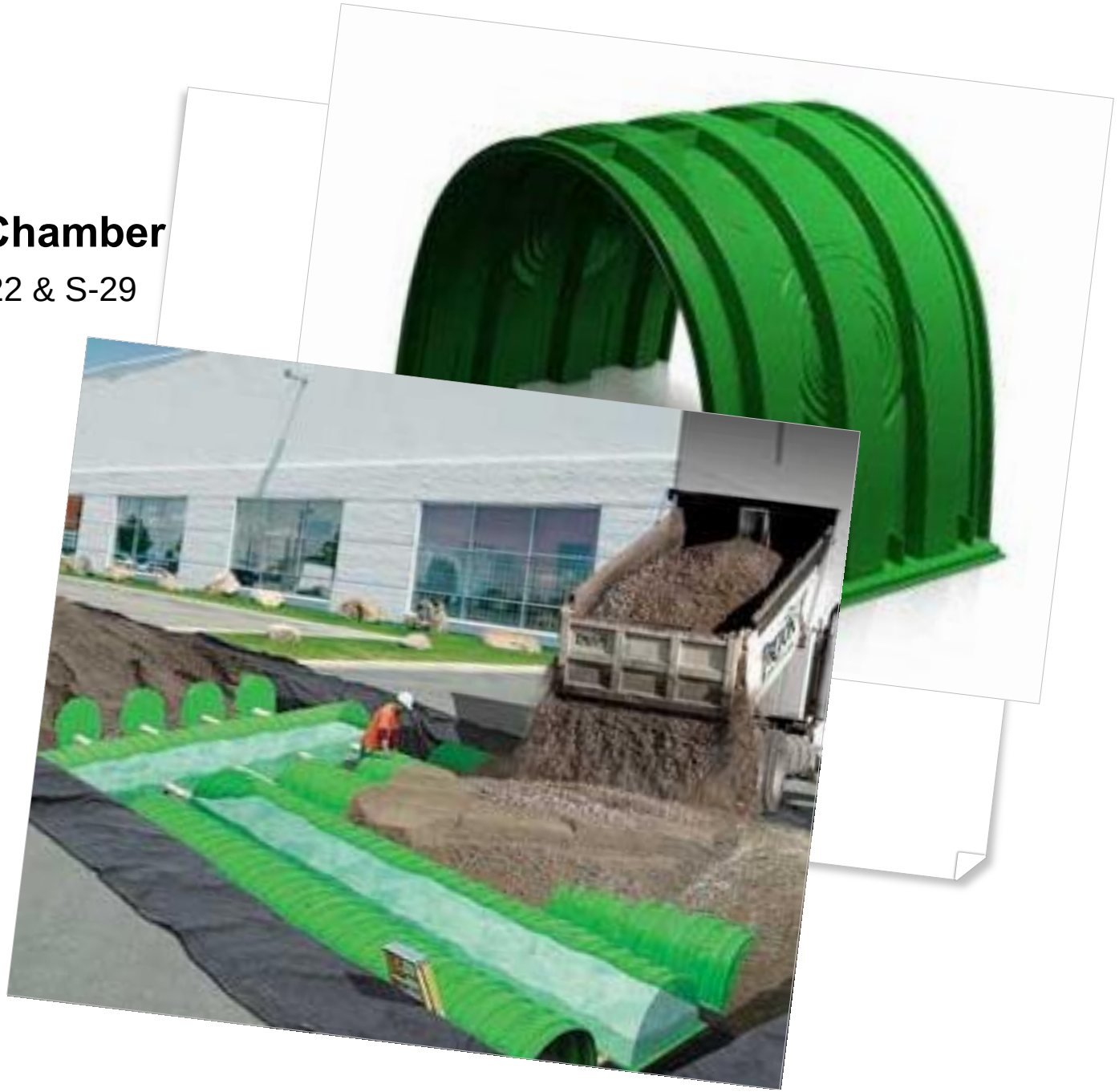
The ‘Yellow’ Chamber

- SC-310, SC-740, DC-780, MC-3500 &MC-4500

Triton

The ‘Green’ Chamber

- M-6, C-10, S-22 & S-29



HydroLogic Solutions

The ‘Orange’ Chamber

- StormChamber

Cultec

The ‘Blue Stripe’ Chamber

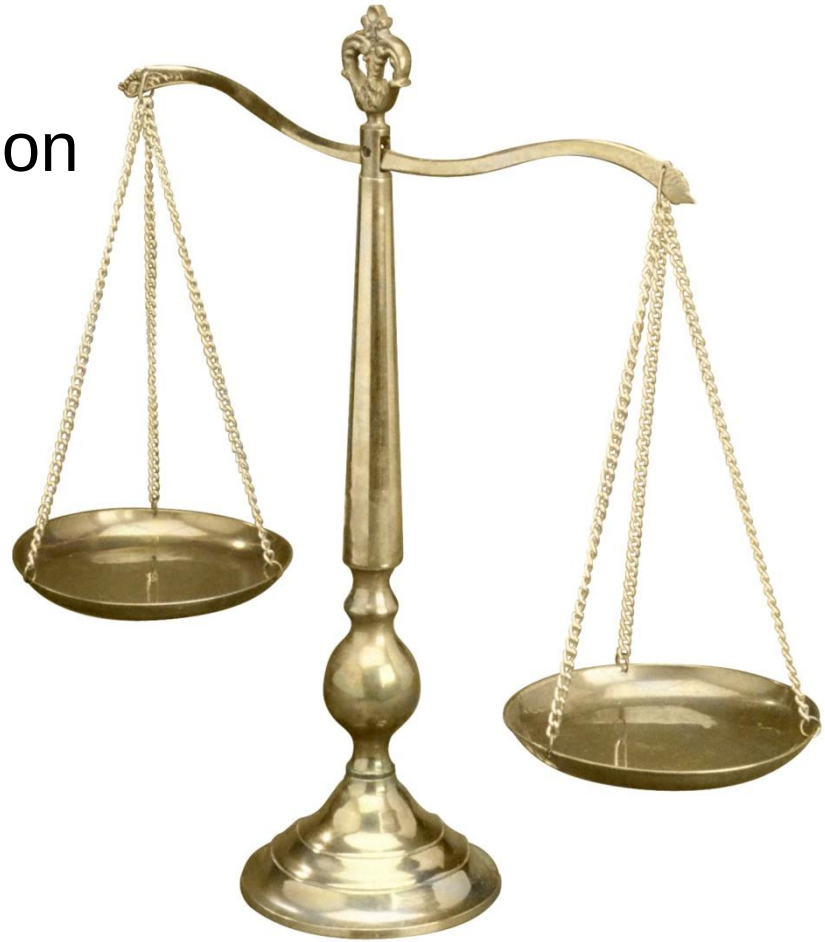
- 100HD, 150XLHD, 280HD, 330XLHD, V8HD & 900HD

Contech

- ChamberMaxx
- Terra Arch 26 & 48

DESIGN CONSIDERATIONS

- Attenuation
- Infiltration
- Filtration or Extended Detention
- Footprint/Space Constraints
- Depth of Bury
- Depth of Foundation Stone
- O&M
- $$$ Cost $$$



STONE REQUIREMENTS

Table 6 – Acceptable Fill Materials

Material Location			
(D) Fill Material for layer 'D' sta the top of the 'C' layer to the bo flexible pavement or unpaved f grade above. Note that paveme base may be part of the 'D' laye			s. Paved installations may have ıration requirements.
(C) Fill Material for layer 'C' sta from the top of the embedment ('B' layer) to 18" (457 mm) abo top of the chamber. Note that p subbase may be part of the 'C'			(305 mm) of material over the ɔact additional layers in 6" ı. 95% Standard Proctor density. not to exceed 12,000 lbs. (53 kN). d 20,000 lbs. (89 kN).
(B) Embedment Stone surrounc chambers from the foundation to the 'C' layer above.	(19 mm		
(A) Foundation Stone below the chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone, nominal size distribution 3/4 - 2" (19 mm - 51 mm)	3, 357, 4, 467, 5, 56, 57	Plate compact or roll to achieve a 95% Standard Proctor Density (see notes).

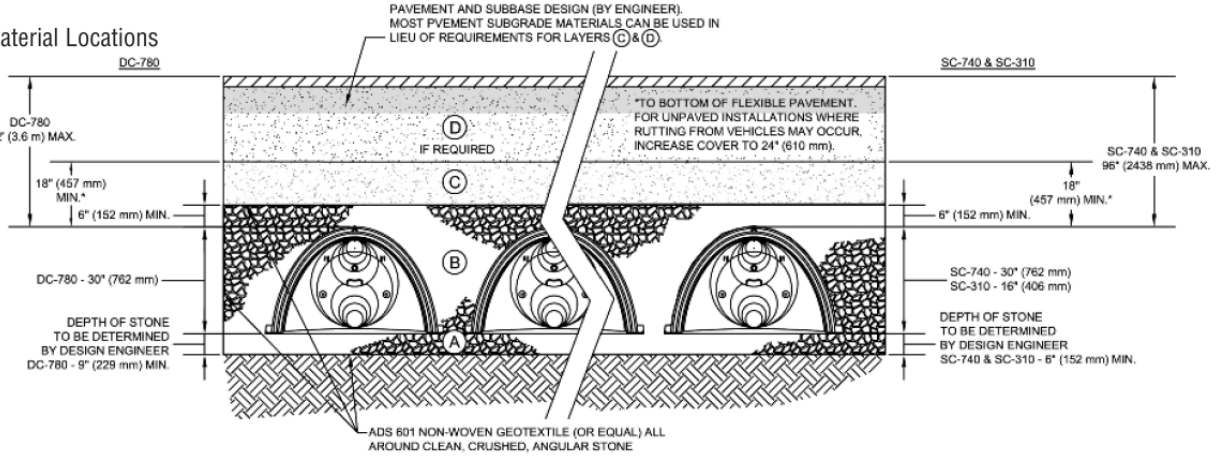
Clean, crushed, angular stone, nominal size distribution ¾ - 2" (19mm – 51mm)

Clean, crushed, angular stone, nominal size distribution ¾ - 2" (19mm – 51mm)

PLEASE NOTE: 1. The listed AASHTO designations are for gradations only. The stone must also be clean, crushed, angular. For example, a specification for #4 stone would state: "Clean, crushed, angular no. 4 (AASHTO M43) stone." 2. As an alternate to Proctor Testing and field density measurements on open graded stone, StormTech compaction requirements are met for 'A' location materials when placed and compacted in 9" (229 mm) (max.) lifts using two full passes with an appropriate compactor.

Figure 6 – Fill Material Locations

Once layer 'C' is placed any soil/ material can be placed in layer 'D' up to the finished grade. Most pavement subbase soils can be used to replace the materials requirements of layer 'C' or 'D' at the design engineer's discretion.



RECYCLED CONCRETE STRUCTURAL BACKFILL

The following are specifications that StormTech recommends for the acceptance of reclaimed crushed concrete based on criteria for structural integrity.

1. Gradation: The gradation shall meet AASHTO M43 gradations as listed in “Table 2 – Acceptable Fill Materials” in the StormTech Design Manual. Note that the material shall be processed such that fines are 5% or less.
2. The material shall meet ASTM D2488 angular or subangular classification.
3. Deleterious materials shall be limited to: a) maximum 20% reclaimed pavement materials and b) maximum 0.15% building materials.
4. Material hardness – Maximum loss of 40% in the LA Abrasion test (AASHTO T96)
5. Freeze-Thaw Resistance – Maximum 12% loss after 5 cycles in magnesium sulfate solution (AASHTO T104)
6. The design shall be in accordance with the StormTech Design Manual and Installation shall be in accordance with the StormTech Installation Instructions.

ACCEPTABLE STONE GRADATIONS

Size Number	Percent By Weight Passing Each Laboratory Sieve														
	4"	3½"	3"	2½"	2"	1½"	1"	¾"	½"	3/8"	No. 4	No. 8	No. 16	No. 50	No. 100
1	100	90–100	–	25–60	–	0–15	–	0–5							
2			100	90–100	35–70	0–15	–	0–5							
24			100	90–100	–	25–60	–	0–10	0–5						
3				100	90–100	35–70	0–15	–	0–5						
357				100	95–100	–	35–70	–	10–30	–	0–5				
4					100	90–100	20–55	0–15	–	0–5	–				
467					100	95–100	–	35–70	–	10–30	0–5				
5						100	90–100	20–55	0–10	0–5	–				
56						100	90–100	40–85	10–40	0–15	0–5				
57						100	95–100	–	25–60	–	0–10	0–5			
6							100	90–100	20–55	0–15	0–5	–			
67							100	90–100	–	20–55	0–10	0–5			
68							100	90–100	–	30–65	5–25	0–10	0–5		
7								100	90–100	40–70	0–15	0–5	–		
78								100	90–100	40–75	5–25	0–10	0–5		
8									100	85–100	10–30	0–10	0–5		
89									100	90–100	20–55	5–30	0–10	0–5	
9										100	85–100	10–40	0–10	0–5	
10										100	85–100	–	–	–	10–30

FOUNDATION DEPTH FOR CHAMBERS

Table 1 – SC-740 and SC-310 Minimum Required Foundation Depth in inches (millimeters)

Cover Ht. ft. (m)	Minimum Required Bearing Resistance for Service Loads ksf (kPa)																					
	4.1 (196)	4.0 (192)	3.9 (187)	3.8 (182)	3.7 (177)	3.6 (172)	3.5 (168)	3.4 (163)	3.3 (158)	3.2 (153)	3.1 (148)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
1.5 (0.46)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2 (0.61)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)
2.5 (0.76)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)
3 (0.91)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)
3.5 (1.07)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
4 (1.22)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
4.5 (1.37)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
5 (1.52)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
5.5 (1.68)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
6 (1.83)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)
6.5 (1.98)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	24 (610)
7 (2.13)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)
7.5 (2.29)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	27 (686)
8 (2.44)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

DESIGN RESOURCES/TOOLS

- Manufacturer's Websites Include:
  - Videos
  - Design Manuals
  - Tech Sheets
  - Case Studies
  - Design Details and Specifications
- Manufacturer's offer design support and free CAD layouts specific for your site
- HydroCAD and Autodesk Storm and Sanitary Analysis Software

THANK YOU, QUESTIONS?

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